

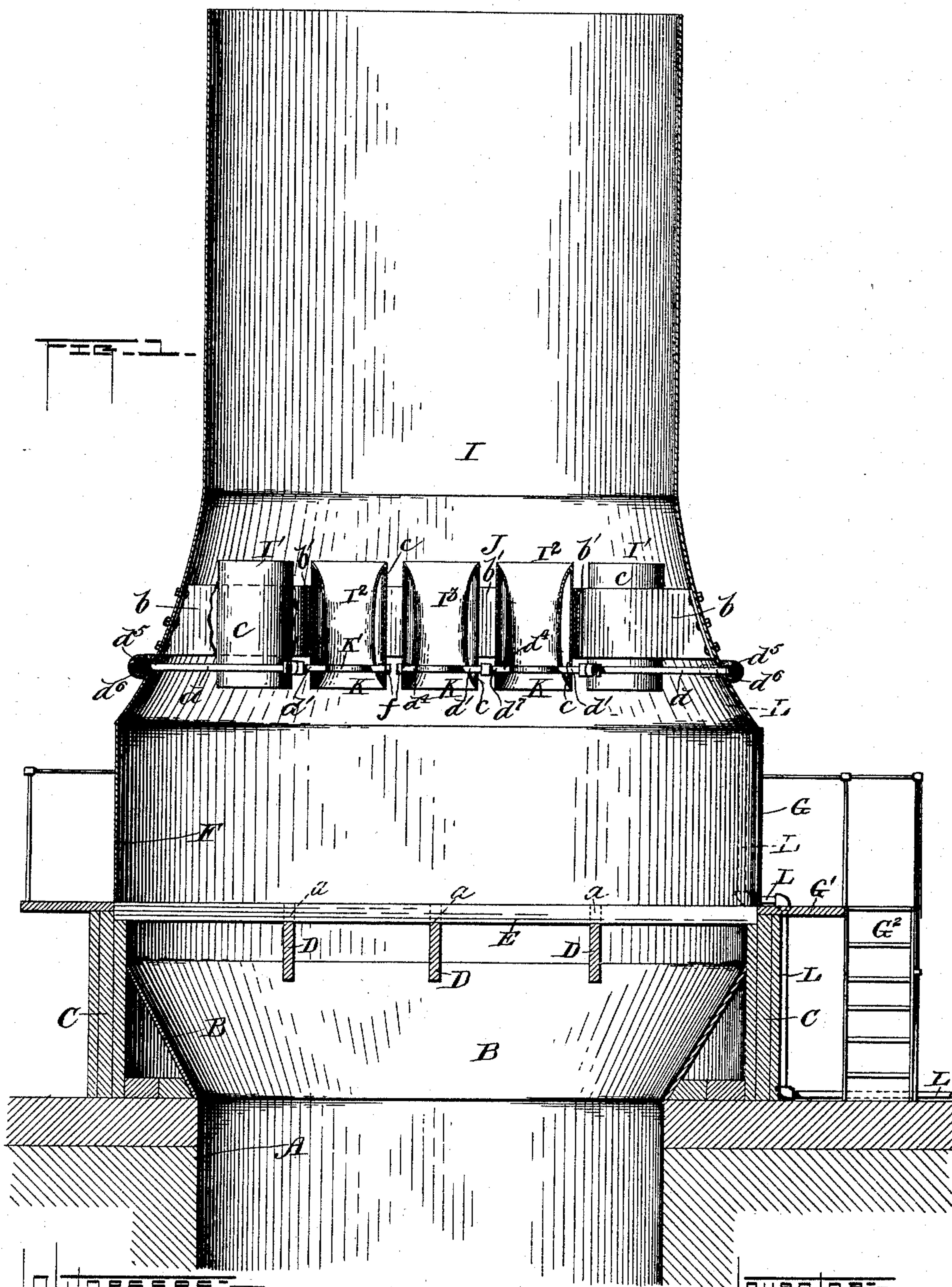
(No Model.)

3 Sheets—Sheet 1.

W. McCLAVE.
COMPOUND STEAM JET BLOWER.

No. 485,821.

Patented Nov. 8, 1892.



Witness:
E. J. Fenwick

Inventor:
William McClave
by his Attorney,
Mason, Fenwick and Lawrence

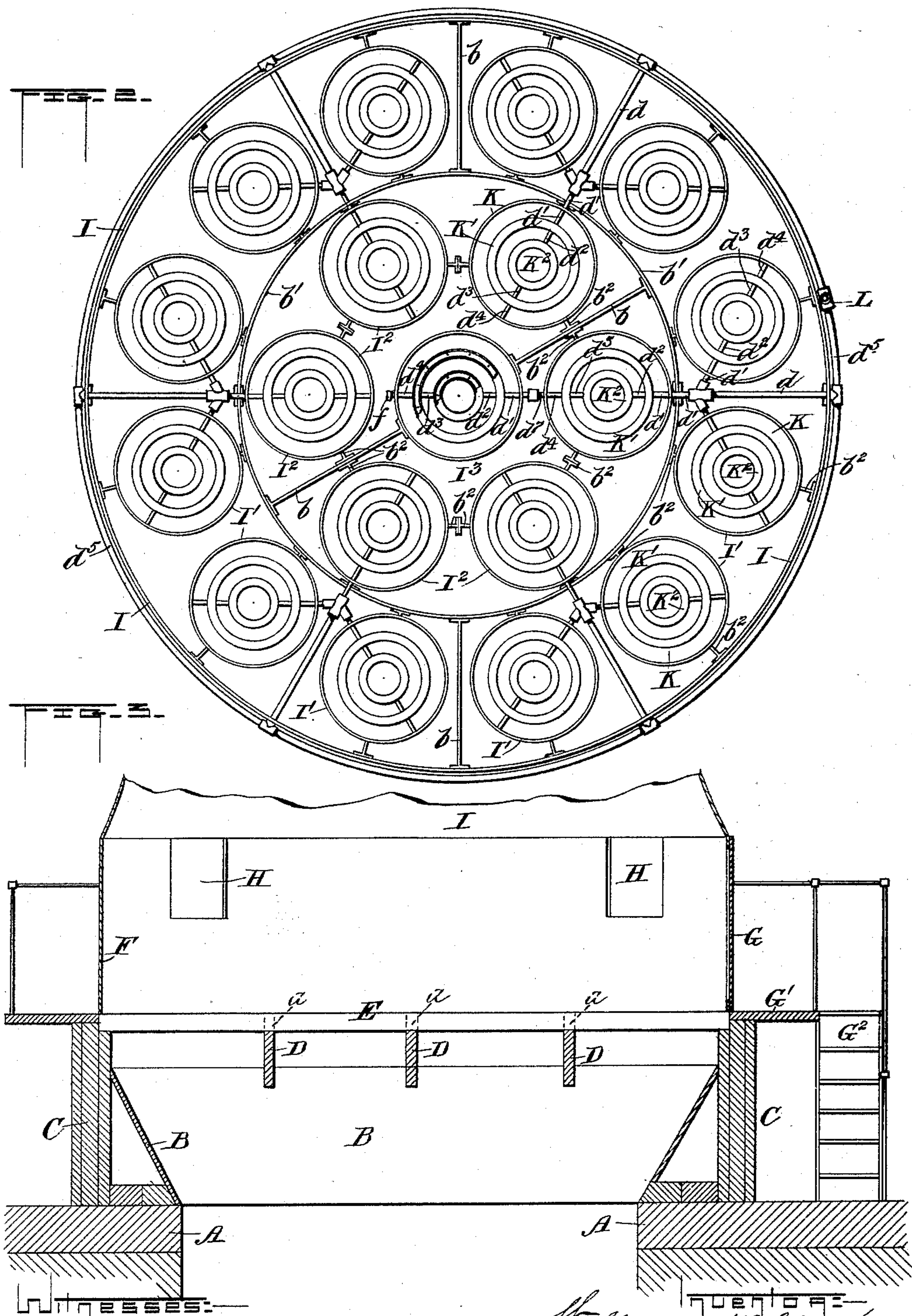
(No Model.)

3 Sheets—Sheet 2.

W. McCLAVE.
COMPOUND STEAM JET BLOWER.

No. 485,821.

Patented Nov. 8, 1892.



Witness:
G. J. Fenwick

Witness:
William McClave
by his Attorneys
Mason, Fenwick & Lawrence

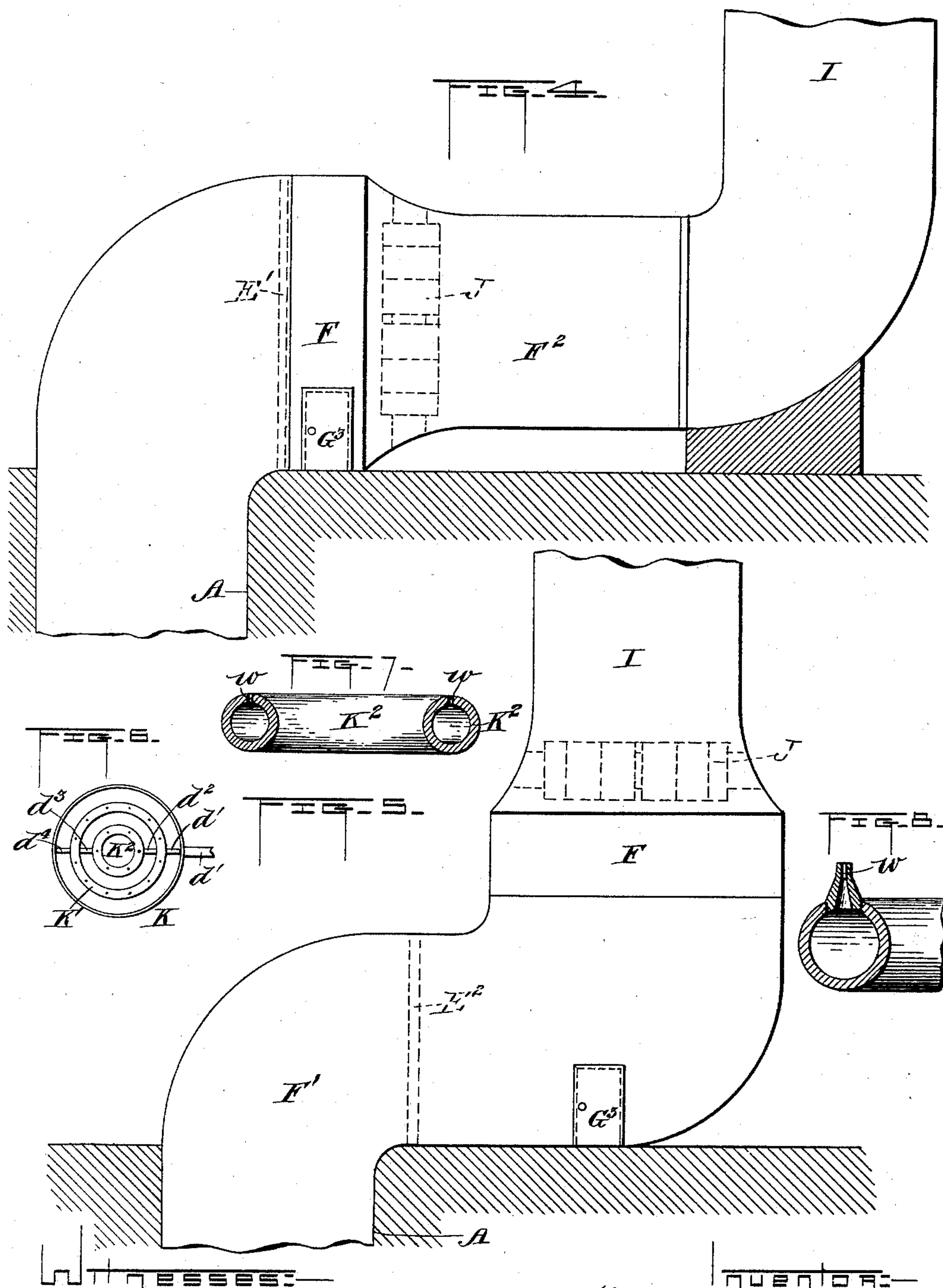
(No Model.)

3 Sheets—Sheet 3.

W. McCLAVE.
COMPOUND STEAM JET BLOWER.

No. 485,821.

Patented Nov. 8, 1892.



Severance.
 E. J. Furber

William M. Clave
by his Attorneys
Mason, Fenwick & Lawrence

UNITED STATES PATENT OFFICE.

WILLIAM McCCLAVE, OF SCRANTON, PENNSYLVANIA.

COMPOUND STEAM-JET BLOWER.

SPECIFICATION forming part of Letters Patent No. 485,821, dated November 8, 1892.

Application filed October 28, 1891. Serial No. 410,073. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM McCCLAVE, a citizen of the United States, residing at Scranton, in the county of Lackawanna and State of Pennsylvania, have invented certain new and useful Improvements in Compound Steam-Jet Blowers; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

My invention relates to steam-jet blowers for ventilating mines and for other analogous uses; and its object is to furnish a compound steam-jet blower of great suctional or exhausting capacity and as such adapted for being successfully and economically applied for ventilating mines and for other analogous useful purposes—as, for instance, in places where it has been customary to employ a large, costly, and powerful fan which requires the power of a steam-engine and the skill of an engineer in its operation and entails considerable pecuniary expense—and my steam-jet blower is also to be such that it will not in its use consume much more, if any more, steam than is expended in driving a fan of the above-mentioned character, while all the expense for the fan, engine, wear and tear of machinery, and the running expenses, including engineer's wages, are avoided; and to this end I have devised a steam-jet blower comprising a large main outer air duct or casing, and arranged inside of this outer air-duct, in relief from the inner surface of its wall, a series of steam-jetting devices, the steam-delivery of each having a plurality of jet-passages of cylindrical bore at and for a sufficient distance back from their outlet ends to insure the formation of well-defined paralld-sided steam-jets before they issue from said passages, each of said steam-jetting devices being arranged to induct or draw air into and through one of the air-ducts, each of such steam-jetting devices, in combination with a small air-duct, constituting a properly-arranged steam-jet blower of certain unitary power for inducting and projecting air, and these blowers in their aggregated capacity being arranged to draw air through the outer or main air-duct, also between the inner surface of said main air-duct, and the outer surfaces of the

first series of air-ducts, and also between their own outer surfaces, and force the same in a large powerful volume through an extension-shaft of the main air-duct, thus producing, constantly, a large partial vacuum behind and between the aggregation of single blowers and also between the inner surface of the main air-duct and the outer series of small blowers, which is constantly filled with foul or vitiated air from the mine-shaft or other place below or behind the compound blower, which foul air is discharged in the usual manner above the mine into the open air or other place, while pure fresh air flows into the places from which it has been sucked at the bottom of the mine through the ordinary channel-ways which are usually provided in mine ventilation.

My invention also consists in certain novel constructions, arrangements, and combinations whereby one, two, three, or more series of unitary steam-blowers having steam-jetting devices, in each of which is a plurality of jet-passages of cylindrical bore at and for some distance back of their outlet ends, each of which series and units of each series having steam supplied to them, while each unitary blower is arranged to induct air through its own shell or case, and all the blowers being adapted for working in conjunction with the outer main air-duct, whereby the passage of the air between the ducts or casings of the small blowers, and also between the inner surface of the outer or main air-duct and the casings of the outer series of the small blowers, is facilitated, and at the same time the compound blower can be properly and safely applied to the air-shaft of a mine or other place, as will be hereinafter described and specifically claimed.

In the drawings, Figure 1 is a vertical section of the upper portion of a mine-shaft with my improved compound blower applied to it, some of the inner small air-duct casings being shown in elevation and some in section, and the main steam-supply receiving and connecting ring being sectioned and the branches shown in elevation, and the steam-jetting devices of the blowers and their connections being also shown in elevation. Fig. 2 is a view from the under side of the compound blower, a portion of the central

steam-jetting device being broken away to show the steam-jet passages in the top sides of the same. Fig. 3 is a broken vertical sectional view showing the mine-shaft provided with windows, opposite which lanterns may be placed to give light to the inside of the chamber above a grated platform of the shaft. Fig. 4 is a broken vertical section illustrating my compound blower (shown by dotted lines) applied in a horizontal air-duct instead of a vertical one. Fig. 5 is a similar view to Fig. 6, illustrating my compound blower (shown by dotted lines) applied in a vertical branch connected to a horizontal branch of the mine-shaft or air-duct. Fig. 6 is a detail view of one of the small or unit blowers and its air-duct as seen from the top side or upper end. Fig. 7 is a vertical cross-section of one of the steam-jet rings, showing the cylindrically-bored jet-passages. Fig. 8 is a vertical cross-section of a portion of one of the steam-jet rings, showing a nipple screwed into the ring and constructed with a jet-passage having a cylindrical bore extending back some distance from the escape end into a backwardly-flared inducting-passage connecting with the main channel of the ring.

In the drawings, Figs. 1 and 3, A is the upper portion of a mine-shaft terminated with a flare, as indicated at B. Around this flared portion a wall or strong housing is constructed, and across the upper portion of the same strong floor-beams D are arranged, said beams being notched or grooved at *a*, and into said grooves strong bars E, forming a safety-grated floor, are set as shown. Air can pass up between the bars; but attendants of the mine and other persons cannot fall into the shaft between the bars, as they are placed close enough to each other to prevent a person falling between them. Above this grated flooring a strong casing F, preferably cylindrical, is provided with a door or doors, as G, leading to a stairway-platform G' and stairs G², as illustrated, or in any other suitable manner. As shown in Fig. 3, the casing F may be provided with a window H, on the outside of which lanterns may be hung or placed for lighting up the chamber above the grated floor. The upper part of the mine-shaft is connected by its casing F with a main air-duct casing I, or it may have an approximately-S-shaped trunk or casing, as F' or F², constructed and arranged as illustrated in Figs. 4 and 5, and a vertical safety-grating formed of bars, as E' or E², (shown by dotted lines in said figures,) may be substituted for the horizontal bars E. (Shown in Figs. 1 and 3.) Thus with either construction persons walking around the top of the shaft will be prevented from falling into it. Doors G³, similar to those G shown in Fig. 1, are provided in the chamber of the trunk communicating with the mine-shaft, and these doors are behind the gratings E' or E², or between it and the place where the compound steam-jet blower J is placed. The doors in all of the

constructions are for admitting access to the main casing or air-duct I of the compound blower, so that the steam-jetting devices K of ring or other form of the compound blower may be set in position, repaired, or renewed.

Referring to Figs. 1 and 3, it will be seen that I have shown the outer or main casing or duct I with a flaring base and a cylindrical extension beyond said base and that it is mounted upon the casing F. If desired, the flaring base may connect with the housing at the upper end of the mine-shaft, and it may be conical or bell-shaped. This casing I forms the main air-duct of the compound steam-blower J, and within it twelve smaller inner casings or air-ducts I' (see Figs. 1 and 2) are shown arranged in a circle, each in relief from the inner surface of the wall of the casing I and also from one another, and within the circle formed by this series of inner casings or air-ducts six similar casings or air-ducts I² are arranged in a circle in relief from the series I' and also from one another, and within the circle of this series of inner casings or air-ducts a single casing or air-duct I³ is arranged in relief from said latter series of casings or air-ducts. The said inner casings or air-ducts are sustained in the main casing or air-duct by means of narrow radial tie-pieces *b*, which are bolted to said main casing, to a circular band *b'*, and to the inner casings, and they are further sustained by T-iron pieces *b*² applied between the main casing, the inner casings, some of the radial tie-pieces, and the casings, as illustrated, or in any other suitable equivalent manner which will offer but very slight obstruction to the passage of the air out of the mine through the blower J which are preferably of much less width than the length of the inner casings, as shown. The inner casings or air-ducts are preferably flared or bell-shaped at both ends, and consequently are hollowed on their outer surfaces and bulged on their inner surfaces, and in order to make their outer surfaces straight or parallel with one another straight or cylindrical tubes *c* are fitted around the inner casings or air-ducts. This prevents the air falling in and hanging upon the hollowed surfaces of the casings or air-ducts and at the same time admits of the inner casings being constructed of light metal and, as usual, contracted or bulged between their bell-shaped ends, thus saving expense for metal and making the casings much lighter than if made solid and bulged inwardly, flared at their ends and straight or parallel on their outer surfaces, which construction is essential for a more perfect operation and insuring a rapid free flow of the air between the inner casings or air-ducts. Within each inner casing or air-duct a steam-jetting device K, which may consist of one, two, or more steam-jet rings, as K' K², may be arranged, said rings being connected by hollow branches *d'* *d*² *d*³ *d*⁴ and these branches connected with hollow radial branches *d* of a

suitably packed or insulated circular hollow ring d^5 , surrounded with a heat-retaining or a non-conducting packing d^6 and connected to the supply-pipe L of a steam-boiler or other source of steam-supply, which supply is preferably "high-pressure" steam. The supply-pipe L is shown by dotted and full lines in Fig. 1 as arranged below the compound blower; but it may be arranged in any other more convenient manner. The arrangement of the branch steam-pipes is such, as will be seen from the drawings, that two of the outer circle and one of the inner circle of steam-jetting devices of the small blowers are connected by a radial and diagonally-arranged branch sections of pipe, while the steam-jet device of the central blower is connected by an extension d^7 of one of the steam-jetting devices of the inner circle of small blowers; also, that the inner blowers are all sustained in the firmest manner within the outer or main casing by very light, narrow, and shallow connections bb' , which do not interfere seriously with the passage of air through the compound blower. As is usual in steam-blowers, the pipe passing through the ducts or casings of the respective steam-jet blowers may be provided with an extension branch, on which is a removable cap f , by removing which the steam-jetting devices may be cleaned by blowing off steam through the same.

It is very important in a compound steam-jet blower that a plurality of spaced steam-jet passages w , the bores of which, respectively, shall be cylindrical for a length, say, not less than about the diameter at the delivery end, should be provided within each inner casing, so that a number of small jets having their velocity or force maintained by the cylindrical form of the bore of the passage shall present their respective surfaces to the air sucked in, and thus a very large amount of peripheral steam-surface and consequent drawing-power secured and a larger quantity of air caused to come in contact therewith and to be carried and forced along with the steam than with a single jet-passage having a cross-sectional area equal to the plurality of jet-passages. When a number of small-spaced, cylindrically-bored, or parallel-sided jet-outlet passages are provided, each jet of steam can have its entire circumference exposed to the air, and the amount of surface secured from a plurality of such circumferences and the power of the blower for drawing in air is increased with an additional consumption of steam. It is also important to have radially-unobstructed airways between the surface of the wall of the main air-duct casing and the surfaces of the inner casings $I^1 I^2 I^3$, and also between the exterior surfaces of the inner casings themselves. In other words, the casings of the small steam-jet blowers should for the best results be separated from one another, and the construction of the inner casings, together with the means for connecting and supporting the different parts of the compound

blower, should be such as to offer but the minimum of obstruction to the passage of the air. The form of foul-air-discharging case shown in Figs. 4 and 5 is adopted when the location of the mine-shaft does not admit of the steam-blower being applied directly over it, and yet it is desired to have the blower discharge the air in a vertical line. With both of the forms shown in Figs. 4 and 5 the main air-duct casing, the inner casings provided with steam-jet devices having a plurality of jet-passages, and the means for sustaining the parts and supplying the steam to the steam-jetting devices will be substantially the same as in Figs. 1 and 2, or equivalents thereof.

Although I have mentioned a specific number of inner air-ducts with steam-jetting devices and given one order of arrangement thereof within the main air-duct and of connecting the small blowers with the steam-supply pipe, I do not wish to be understood as confining myself to such a number, nor to the order of arrangement and manner of supplying steam to the jetting devices, as the result sought can be accomplished in many different equivalent ways without essentially changing the character of my invention. For instance, the series of steam-jetting devices of steam-blowers may be arranged in square, rectangular, or polygonal form, their casings corresponding thereto; but the circular form is preferable to any other.

From the foregoing description it will be understood that by the unitary force of the blast produced by the blowers in the inner casings the said blowers become, in connection with the air-duct casing, to the compound blower what the steam-jets are to the small separate air-duct casings or units, from the fact that they all bear a certain relation to each other and to the air-duct casing, the result being the production of a suction or exhausting power which aggregates the power of all the blowers of the inner air-ducts, together with that of the air drawn in between said air-ducts and between surfaces of the outer series of said ducts and the inner surface of the casing of the main air-duct, and thus is secured all the advantage derived from a single blower having a plurality of separate jet-passages and the additional advantage and effect of an aggregation of the the series of such blowers or units, together with the advantage gained by using the products or blasts of these separate units, with a larger volume of air drawn in between the parts, the whole making up the larger compound blower, all of which blast is discharged into the open air through the outlet end of the main air-duct casing and the effective ventilation of a mine or other place accomplished. It will also be seen that the air-passages between the inner casings are rendered more effective by reason of the exterior surfaces of the said casings being straight instead of dishing, while at the same time by making the exterior surfaces of these inner casings with con-

tracted intermediate portions the advantage of having bell-shaped or large inlet and outlet ends is secured; and, furthermore, it will be seen that by the arrangement of the parts and the connection of the steam-jetting devices in series the action of the whole blower is improved and its construction simplified and durability insured, and, finally, the said compound blower is safely and properly applied for ventilating mines.

What I claim as my invention is—

1. The combination, with the main air-duct, of the inner air-duct placed within the main duct and of steam-jetting devices for the steam-blower, each inner duct having a plurality of steam-jet outlet-passages which are of a cylindrical bore sufficiently far back from their outlet ends to give proper direction and effectiveness to the steam-jets, and one such steam-jet device having a plurality of jet outlet-passages being arranged in each inner duct, substantially as and for the purpose described.

2. The combination, with the main air-duct, of the inner air-ducts within the main air-duct, steam-jet devices for the steam-blower, each

having a plurality of jet outlet-passages of cylindrical bore sufficiently far back from the outlet end to give proper direction and effectiveness to the steam-jets, means for sustaining the inner duct, steam branch pipes for connecting the steam-blowers in series, and also all the steam-jet blowers of the different series, with the supply-pipe of the boiler or other source of supply, substantially as described.

3. The combination, with the main air-duct, of the inner air-ducts comprising two circles of blower-casings and one central blower-casing, all within the main duct, steam-jetting devices having a plurality of jet outlet-passages and means for sustaining the inner ducts, steam branch pipes for connecting all the steam-jet blowers with the supply-pipe of the boiler or other source of supply, substantially as described.

In testimony whereof I hereunto affix my signature in presence of two witnesses.

WILLIAM McCLAVE.

Witnesses:

E. T. FENWICK,

C. SEVERANCE.